ICE CAVES ON EARTH – ANALOGUES FOR (SUB) SURFACE CONDITIONS ON MARS. Aurel Perşoiu[1], B. P. Onac[2, 3, 4], J. G. Wynn[2], K. Žák[5] [1]Department of Geography, University of Suceava, Universităţii 13, Suceava, 720229, Romania, aurel.persoiu@gmail.com, [2]Department of Geology, University of South Florida, 4202 E Fowler Ave. SCA 528, Tampa, 33620, US; [3]Department of Geology, "Babeş Bolyai" University, Cluj Napoca, Romania; [4] "Emil Racoviţă" Institute of Speleology, Cluj Napoca, Romania; [5] Institute of Geology, Academy of Sciences of the Czech Republic, Rozvojová 269, 165 02 Praha 6, Czech Republic.

The exploration of Mars by manned expeditions is likely to happen within the next few decades, with some of the most important tasks being the search for water and life. The most likely candidate to host these two is the Martian underground, including caves. Some recent studies have shown that caves could exists on Mars [1], with some of them theoretically being able to host water in its solid state, i.e., ice [2]. These ice caves could be the hotspots of the quest for water and life, as they provide a unique combination of factors favorable for the genesis, accumulation and preservation of water, sediments, and life forms/remains.

In this paper, we explore some of the possibilities offered by the study of terrestrial ice caves for the future understanding of various past and present Martian processes. The results are based on extensive and intensive study of three ice caves situated in Romania (central Europe): Scărişoara Ice Cave, Focul Viu Ice Cave and Borţig Ice Cave. In all these caves, ice has formed by the freezing of water in successive annual layers, trapping within the ice matrix calcite, surface-derived organic and inorganic matter, air bubbles etc. Climate monitoring, stable isotopes in water, ice and calcite, ice stratigraphy and morphology and pollen analysis have been used to develop possible scenarios and analogues for the Martian environment.

Air temperature data shows that a complex interplay exists between the surface and cave climates, periods of complete shutdown of the connections between them alternating with periods of almost identical behavior. These complications are registered by the stable isotope composition of the ice [3], which acts as a proxy for both air temperature and conditions prevailing during freezing. We present here a method to extract the climatic signal from ice formed by the freezing of water, as well as a method to decipher between ice formed by the freezing of water with a free-surface (e.g., water pools, dripping water etc), freezing of entrapped water and snow diagenesis.

Stable isotopes in cryogenic calcite [4] allowed us to show the presence of liquid water and associated freezing conditions, even in spots where both water and ice are missing today.

Stratigraphic and isotopic analyses have shown that it is possible to reconstruct past cyclic behavior, evidencing seasonal cycles, both on annual and centennial scales; while the analysis of various sediments entrapped in the ice have allowed us to reconstruct past changes in vegetations, pathways of atmospheric transport, intensity of surface extreme climatic events etc.

The results of these studies could be used to devise possible approaches for the study of the Martian environment, including air temperature, wind directions, existence of seasons and/or cyclic climatic changes, presence of water in the past (where it lacks presently), and, maybe most important, show that life might have existed or still exists, preserved in ice.

References: [1] Baioni D. et al. (2009) *Acta carsologica*, *38*, 9-18. [2] Williams K. E. et al. (2010) *Icarus*, *209*, 358-368. [3] Perşoiu A. et al. (2011) *JGR*, *116*, D02111. [4] Žák K. et al. (2008) *Quat. Int.*, *187*, 84-96.